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(21) (A1) 2,191,409
(22) 1996/11/27
(43) 1997/05/30

(51) Int.Cl.[6] H02H 3/22

(19)(CA) **APPLICATION FOR CANADIAN PATENT** (12)

(54) Gas-Filled Surge Voltage Protector

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(30) (DE) 19546151.7 1995/11/29

(57) 6 Claims

Abstract Of The Disclosure

A gas-filled surge voltage protector with electrode terminals having a high current-carrying capacity. The electrode terminals are designed at one end as an open, elastically expandable ring surrounding a cylindrical contact surface of the electrode. In the case of a three-electrode surge protector, a third, similarly formed electrode terminal is included having an open ring surrounding the contact surface of the center electrode.

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GAS-FILLED SURGE VOLTAGE PROTECTOR

Field Of The Invention

The present invention relates to the field of surge voltage protectors for communications networks, and more specifically to the current-carrying elements of the electrodes of a gas-filled surge voltage protector.

Background Information

Gas-filled surge protectors having one, two or three discharge paths are used in communications networks and in related equipment to protect against voltage surges that can occur, for example, as a result of a lightning strike. Such surge protectors consist of two end electrodes and an optional third electrode in the form of a center electrode and one or two cylindrical hollow ceramic insulators. The ceramic insulator in a two-electrode surge protector is usually soldered to the end electrodes at the end (see, e.g., U.S. Patent 4,266,260). In three-electrode surge protectors, the ceramic insulators are soldered to both the center electrode and one of the end electrodes either on the circumference or at the end (see U.S. Patent 3,885,203 or U.S. Patent 4,212,047). The electrodes are contacted on their outer circumference either inside a casing with the help of spring-loaded insulation-piercing connecting devices or with electrode terminals soldered or welded at one end tangentially or radially to one electrode and provided with a pluggable contact element or designed for soldering at the other end (see U.S. Patent 4,212,047 or U.S. Patent 4,984,125).

In known three-electrode surge protectors whose electrodes are made of copper, a contact ring is soldered or welded, etc. to the flanged base part of each end electrode.

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Either the contact ring is already part of the electrode terminal (as described in U.S. Patent 5,388,023) or an electrode terminal can then be welded to its outer circumference (as described in German Published Patent Application No. 43 30 178, which corresponds to U.S. Patent Application Serial No. 290,274, filed on August 15, 1994). This contact ring may have a cylindrical lateral surface. Instead of a contact ring, a contact disk may also be used.

Furthermore, if the electrode is made of a material other than copper, such as Vacon, an iron-nickel alloy, the flanged base part of the electrode may itself have a cylindrical contact surface, preferably with a width of at least approximately 1 mm.

Summary Of The Invention

The present invention provides a gas-filled surge protector having two cup-shaped electrodes whose edges are each soldered to an end of a cylindrical hollow ceramic insulator, where the edge of each electrode is designed as a cylindrical contact surface to which an electrode terminal is attached. The gas-filled surge protector of the present invention has current-carrying elements which allow it to safely and repeatedly withstand even extreme loads, such as those that may occur due to lightning with a current surge of approximately 20 kA.

Such an object is achieved in accordance with the present invention by forming the end of the electrode terminal contacting the cylindrical contact surface as an open ring that surrounds the cylindrical contact surface in a form-fitting manner and which has an inside diameter that matches the diameter of the cylindrical contact surface. The electrode terminal is made of a cold-hammered material such as steel, an iron alloy, bronze or brass. The open ring of the electrode terminal surrounds the cylindrical contact surface for an angle of at least 270° at the circumference and has a rectangular cross section whose width is equal to or approximately equal to the width of the cylindrical contact surface and whose height

is at least equal to its width.

Such a design of the electrode terminals assures a large-area current transfer from the electrode terminal to the respective electrode of the surge protector. To compensate for irregularities in the area of the contact surfaces, it is advisable to electroplate the cylindrical contact surfaces of the electrodes and/or the inside lateral surface of the open ring of the respective electrode terminal with a layer of tin approximately 5 to 15 µm thick. A tin-lead alloy is suitable for this purpose.

The end of the electrode terminal which is designed as an open ring according to the present invention cannot be placed radially on the electrode because of the large angle of more than 270° at the circumference, because of the cross-sectional shape of the ring and because it is made of a cold-hammered material. Instead, the open ring must be forced axially onto the electrode with a slight widening effect. This axial push-mounting can be facilitated by providing a bevel on the inside peripheral edges of the open ring.

In three-electrode surge protectors with two ceramic insulators and a ring-shaped center electrode, the center electrode can be contacted in the same way as the contact rings of the two end electrodes. Thus, the open ring of the electrode terminal is pushed directly onto the center electrode which is designed with a contactable outside surface.

If necessary, the form-fitting connection between the electrode terminals and the electrodes can be stabilized mechanically by applying a spot of soft solder to the edge of the contact surfaces.

Brief Description Of The Drawings

Figure 1 shows a view of an exemplary embodiment of a three-electrode surge protector with electrode terminals in accordance with the present invention.

Figures 2 and 3 show an electrode terminal of the surge protector of Fig. 1.

Figure 4 shows a cross section of an electrode

terminal arranged on a contact ring of an end electrode made of copper.

Figure 5 shows a cross section of an electrode terminal arranged on the contact disk of an end electrode made of copper.

Figure 6 shows a cross section of the arrangement of an electrode terminal on the contact surface of an end electrode made of an iron-nickel alloy.

Detailed Description

Figure 1 shows a three-electrode surge protector with additional fail-safe and vent-safe devices. Two ceramic insulators 4 and 5 are each connected to a center electrode and equipped with end electrodes 2 and 3 at their respective outer ends. According to Figure 4, a contact ring 6 or 7 is soldered onto the end of each end electrode made of copper. Each contact ring 6 and 7 has an approximately rectangular cross section and an outer lateral surface which forms a cylindrical contact surface. An example of such a contact ring is shown in German Published Patent Application No. 43 30 178. An electrode terminal 61 or 71 is applied to the contact surface (not shown in Figure 1) of each of the contact rings 6 or 7, respectively. The center electrode is provided with an electrode terminal 81. A spring clip 11 is attached to the center electrode and includes arms 12 and 13 which support short-circuit caps 14 and 15, respectively, arranged axially with end electrodes 2 and 3. The caps 14 and 15 press auxiliary surge protectors 17 and 18 and a fusible pellet against the two end electrodes 2 and 3. The auxiliary surge protectors 17 and 18 may be spark gaps in air or varistors.

According to Figures 2 and 3, electrode terminals 61, 71 and 81 are each designed as an open ring 9 at the ends contacting the electrodes, so they clamp around the cylindrical contact surface. To assure a sufficient contact force, the inside diameter of open ring 9 and the outside diameter of the cylindrical contact surfaces are designed for a tight fit. To improve contact, a layer of tin 10 approximately 5 to 15 µm

thick is applied to the cylindrical contact surfaces of contact rings 6 and 7. In addition, the inside peripheral edges of the open ring are provided with a chamfer 19.

The cross section of open ring 9 is substantially rectangular, where the width b is equal to the width of contact ring 6, 7 and the height h is slightly greater than the width b. For example, the height h may be 1.5 mm.

The open ring 9 is made of brass, i.e., a copper-zinc alloy. Open ring 9 surrounds the contact ring or the center electrode over an angle α of at least 270° at the circumference, preferably 300 to 330°. Open ring 9 also has a transition to a connecting piece 63, 73 or 83 that is provided with a conventional contact terminal at its other end (not shown). It is advisable to design open ring 9 and the connecting piece as punched parts.

In another embodiment, shown in Figure 5, open ring 9 of the electrode terminal is placed on the cylindrical contact surface of a contact disk 62, which replaces contact ring 6 of Figure 4.

In yet another embodiment, as shown in Figure 6, open ring 9 of the electrode terminal is placed on a cylindrical contact surface formed directly by flanged base part 22 of an electrode 21 made of an iron-nickel alloy.

What is claimed is:

1. A gas-filled surge protector comprising:

a hollow cylindrical ceramic insulator including a cylindrical contact surface proximate to an end of the insulator; and

an electrode terminal attached to the cylindrical contact surface, the electrode terminal including an open ring which surrounds the cylindrical contact surface in a form-fitting manner and having an inside diameter which matches the diameter of the cylindrical contact surface, the electrode terminal being made of a cold-hammered material,

wherein the open ring of the electrode terminal surrounds the cylindrical contact surface over an angular extent of at least 270° of the circumference of the contact surface and has a substantially rectangular cross-section whose width is approximately equal to the width of the cylindrical contact surface and whose height is at least as large as the width of the cross-section of the open ring.

2. The surge protector of claim 1, wherein the electrode is made of a cold-hammered material selected from the group consisting of steel, an iron alloy, bronze and brass.

3. The surge protector of claim 1, wherein a layer of tin is applied by electroplating on the cylindrical contact surface.

4. The surge protector of claim 1, wherein a layer of tin is applied by electroplating on an inside lateral surface of the open ring.

5. The surge protector of claim 1, wherein a chamfer is formed on each inside peripheral edge of the open ring.

6. The surge protector of claim 1, comprising two holllow cylindrical ceramic insulators and a ring-shaped center electrode, the center electrode including an electrode terminal

similar to the electrode terminal attached to the cylindrical contact surface.

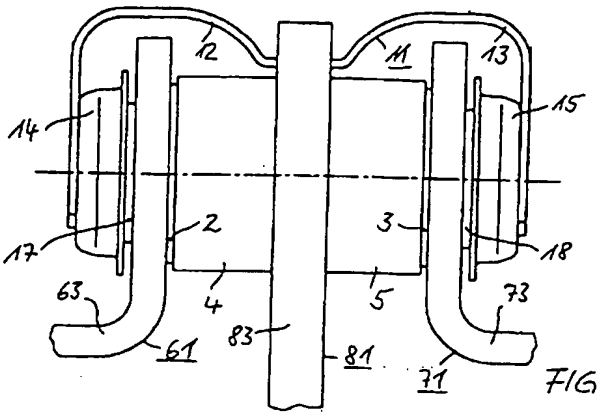


FIG 1

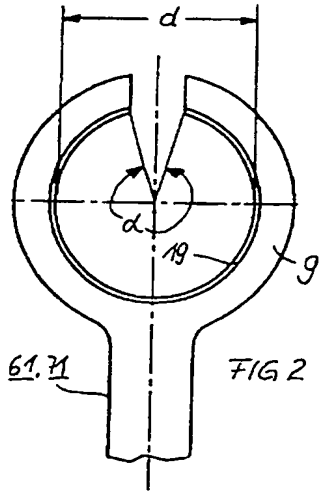
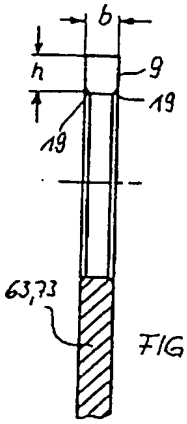


FIG 2



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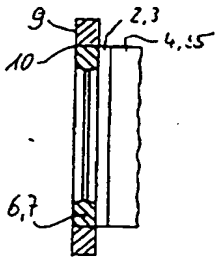


FIG 4

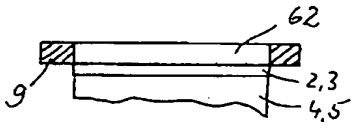


FIG 5

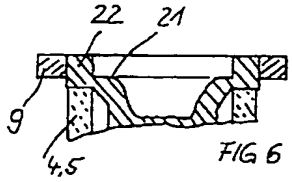
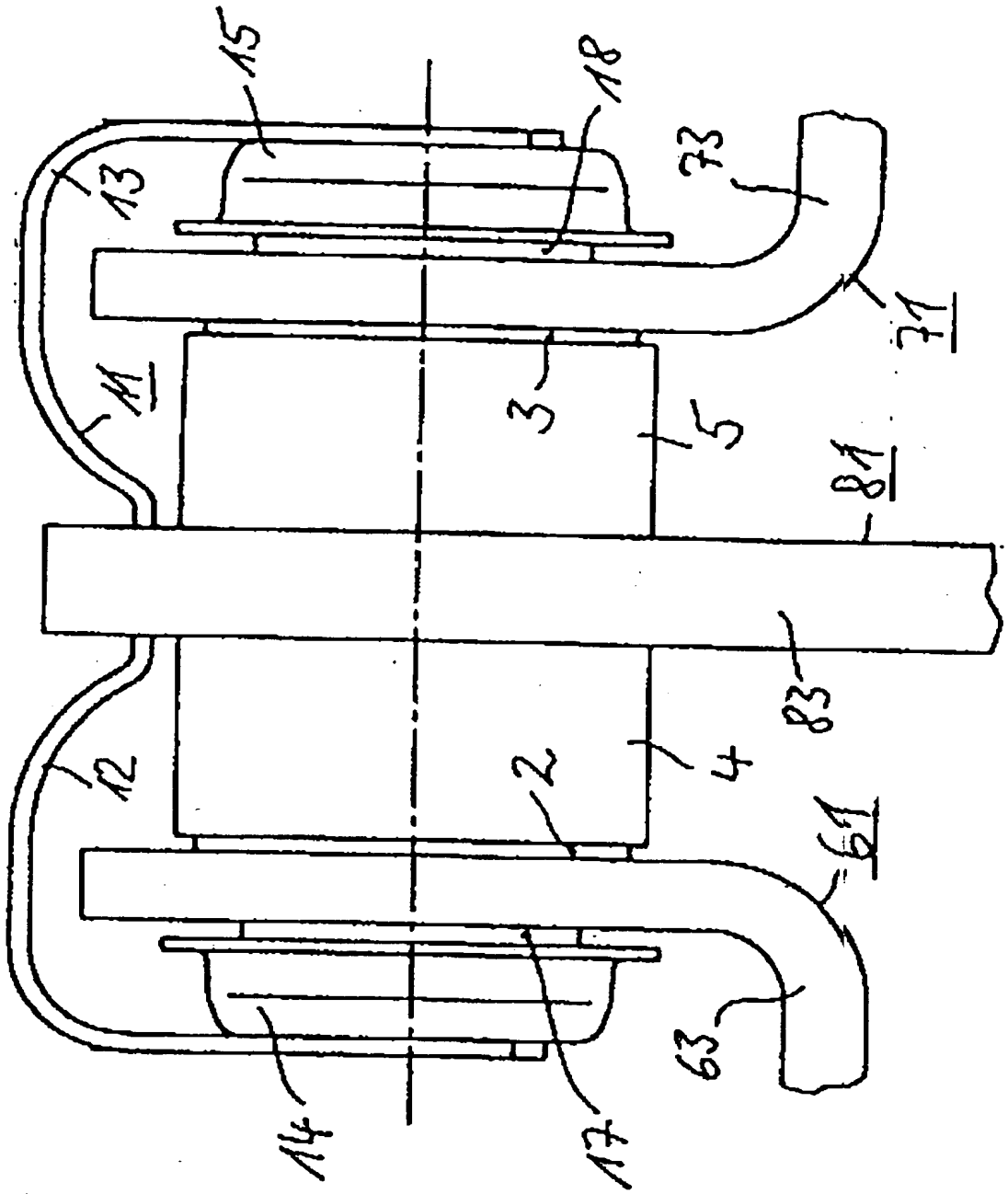


FIG 6

Patent Agents

Fetherstonhaugh & Co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